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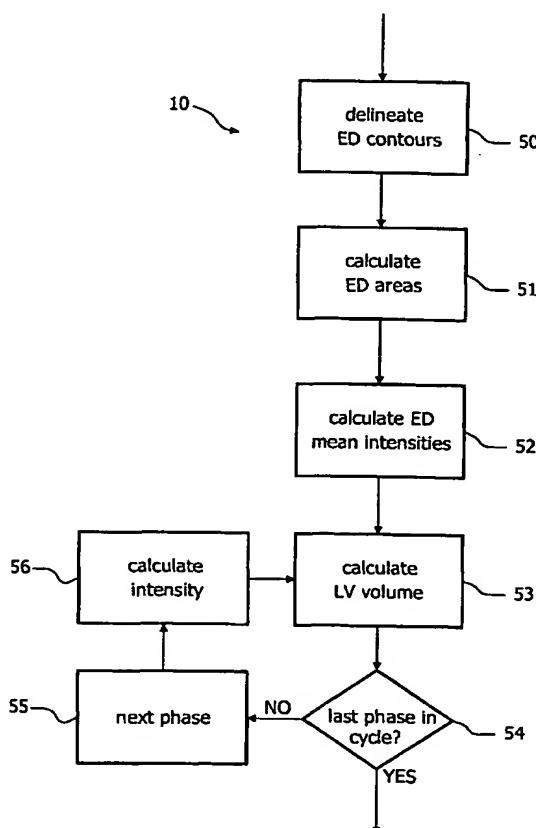
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*[Continued on next page]*

(54) Title: NON-INVASIVE LEFT VENTRICULAR VOLUME DETERMINATION



(57) Abstract: A method of and a computer readable medium comprising a program for calculating total left ventricular (LV) volume during a cardiac cycle. The LV volume is estimated using only endocardial contours in a cardiac 3D image that was acquired at end diastole (ED), i.e. the moment at which the heart is fully relaxed. These contours are manually specified or (semi-)automatically derived. Based on these contours and on the pixel intensity in all other images, the LV volume is estimated based on intensity variations within the area enclosed by the contours (ED LV blood pool). These variations are proportional to the change in size of the ventricle. Hence ventricle volume and other derivable cardiac functionality parameters as well as the phase in the cardiac cycle are derived. The 3D image is previously to the method captured by means of a device for imaging inside parts of a mammal body, such as Magnetic Resonance (MR), Computer Tomography (CT), Nuclear Medicine (NM) or Ultrasound (US) devices.

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## INTERNATIONAL SEARCH REPORT

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<b>A. CLASSIFICATION OF SUBJECT MATTER</b>					
IPC 7	G06K9/00	A61B5/055	G06T5/00	A61B5/00	A61B8/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/072672 A1 (ROUNDHILL DAVID N ET AL) 13 June 2002 (2002-06-13) paragraph '0040!; claims 1,4,5,12 -----	1,8,11
X	US 2002/151793 A1 (GEISER EDWARD A ET AL) 17 October 2002 (2002-10-17) paragraphs '0025!, '0026!; claims 1,6 -----	1,8
X	US 5 435 310 A (BOLSON EDWARD L ET AL) 25 July 1995 (1995-07-25) abstract; claim 1 -----	1,6-8
A	WO 2004/019275 A (MULET PARADA MIGUEL ;DECLERCK JEROME (GB); FELDMAR JACQUES (GB); M) 4 March 2004 (2004-03-04) page 2, line 6 -page 5, line 13; claims 1,13 -----	1-21
		-/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

* Special categories of cited documents :	<ul style="list-style-type: none"> <li>*A* document defining the general state of the art which is not considered to be of particular relevance</li> <li>*E* earlier document but published on or after the international filing date</li> <li>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</li> <li>*O* document referring to an oral disclosure, use, exhibition or other means</li> <li>*P* document published prior to the international filing date but later than the priority date claimed</li> </ul>
Date of the actual completion of the international search	<ul style="list-style-type: none"> <li>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</li> <li>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</li> <li>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</li> <li>*&amp;* document member of the same patent family</li> </ul>

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Name and mailing address of the ISA	European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer	Chopinaud, M

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 107 838 A (YAMAGUCHI KOJIRO) 28 April 1992 (1992-04-28) the whole document -----	1,10
A	US 5 570 430 A (SHEEHAN FLORENCE H ET AL) 29 October 1996 (1996-10-29) abstract; claim 1 -----	1-21

## INTERNATIONAL SEARCH REPORT

IB2004/050503

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2002072672	A1	13-06-2002	NONE		
US 2002151793	A1	17-10-2002	US US	6346124 B1 2003153823 A1	12-02-2002 14-08-2003
US 5435310	A	25-07-1995	US	5601084 A	11-02-1997
WO 2004019275	A	04-03-2004	WO	2004019275 A1	04-03-2004
US 5107838	A	28-04-1992	JP	4218139 A	07-08-1992
US 5570430	A	29-10-1996	US	5734739 A	31-03-1998